

Amendments to the Claims:

The following lists all claims and their status:

1-2618. (cancelled)

2619. (currently amended): A method of treating a coal formation in situ, comprising:
heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element, and wherein superposition of heat from two of the heating elements raises a temperature of the part between the two heating elements to a temperature within a pyrolysis temperature range in order to pyrolyze at least some hydrocarbons in the part of the formation.

2620. (cancelled)

2621. (currently amended): The method of claim 2619, further comprising maintaining a temperature within a majority of the part within the pyrolysis temperature range during pyrolysis, and wherein the pyrolysis temperature range spans from about 250 °C to about 370 °C.

2622. (previously presented): The method of claim 2619, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

2623. (previously presented): The method of claim 2619, wherein at least one of the heating elements comprises a flameless distributed combustor.

2624. (currently amended): The method of claim 2619, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within at least one of the wellbores.

2625. (previously presented): The method of claim 2619, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

2626. (currently amended): The method of claim 2619, further comprising controlling a pressure and a temperature ~~within~~in at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2627. (currently amended): The method of claim 2619, further comprising controlling the heat such that an average heating rate of the heated part is less than about 1 °C per day in a ~~pyrolysis temperature~~ range of about 270 °C to about 400 °C.

2628. (currently amended): The method of claim 2619, wherein heating the part of the formation further comprises:

heating a selected volume (V) of the coal formation from at least one of the heating elements, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons ~~within~~in the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h*V*C_v*\rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

2629. (previously presented): The method of claim 2619, wherein heating the part of the formation comprises transferring heat substantially by conduction.

2630. (previously presented): The method of claim 2619, further comprising heating the part of the formation to increase a thermal conductivity of the part to greater than about 0.5 W/(m °C).

2631. (cancelled)

2632. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

2633. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

2634. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

2635. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

2636. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

2637. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

2638. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

2639. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

2640. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

2641. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

2642. (currently amended): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume ~~of the non-condensable component, and wherein the molecular hydrogen is and~~ less than about 80 % by volume of the non-condensable component at 25 °C and one atmosphere absolute pressure.

2643. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

2644. (original): The method of claim 2619, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

2645. (currently amended): The method of claim 2619, further comprising controlling a pressure withinin the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2646. (currently amended): The method of claim 2619, further comprising controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ withinin the mixture is greater than about 0.5 bar.

2647. (currently amended): The method of claim 2646, wherein the partial pressure of H₂ withinin the mixture is measured when the mixture is at a production well.

2648. (currently amended): The method of claim 2619, further comprising altering a pressure withinin the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

2649. (original): The method of claim 2619, further comprising producing a mixture from the formation and controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation.

2650. (currently amended): The method of claim 2619, further comprising:
providing hydrogen (H₂) to the heated part to hydrogenate hydrocarbons withinin the heated part; and
heating a portion of the heated part with heat from hydrogenation.

2651. (previously presented): The method of claim 2619, further comprising:
producing hydrogen (H₂) and condensable hydrocarbons from the formation; and

hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2652. (previously presented): The method of claim 2619, wherein heating increases a permeability of a majority of the heated part to greater than about 100 millidarcy.

2653. (currently amended): The method of claim 2619, wherein heating increases a permeability of a majority of the heated part, such that the permeability of the majority of the heated part of the formation is substantially uniform.

2654. (original): The method of claim 2619, wherein the heating is controlled to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by Fischer Assay.

2655. (previously presented): The method of claim 2619, further comprising producing a mixture in a production well, and wherein at least about 7 heating elements are disposed in the formation for each production well.

2656. (previously presented): The method of claim 2619, further comprising providing heat from three or more heating elements to at least a portion of the formation, wherein three or more of the heating elements are located in the formation in a unit of heating elements, and wherein the unit of heating elements comprises a triangular pattern.

2657. (previously presented): The method of claim 2619, further comprising providing heat from three or more heating elements to at least a portion of the formation, wherein three or more of the heating elements are located in the formation in a unit of heating elements, wherein the unit of heating elements comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

2658-5149. (cancelled)

5150. (previously presented): The method of claim 2619, wherein heating the part of the formation comprises transferring heat from the heating elements substantially by radiation.

5151. (currently amended): A method of treating a coal formation in situ, comprising:

heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal expansion of the at least one heating element, and wherein superposition of heat from at least two of the heating elements pyrolyzes at least some hydrocarbons in the part of the formation; and

producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5152. (previously presented): The method of claim 5150, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

5153. (previously presented): The method of claim 5150, wherein at least one of the heating elements comprises a flameless distributed combustor.

5154. (currently amended): The method of claim 5150, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within the wellbore.

5155. (previously presented): The method of claim 5150, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

5156. (currently amended): A method of treating a coal formation in situ, comprising:

heating a part of the formation with heating elements, wherein at least two of the heating elements are placed in open wellbores, wherein at least one end of at least one of the heating elements is free to move axially within one of the open wellbores to allow for thermal

expansion of the at least one heating element, and wherein superposition of heat from at least two of the heating elements pyrolyzes at least some hydrocarbons in the part of the formation; and
controlling the pressure of a majority of the part of the formation at or above 2 bar absolute.

5157. (previously presented): The method of claim 5156, wherein at least one of the heating elements comprises a pipe-in-pipe heater.

5158. (previously presented): The method of claim 5156, wherein at least one of the heating elements comprises a flameless distributed combustor.

5159. (currently amended): The method of claim 5156, wherein at least one of the heating elements comprises a mineral insulated cable coupled to a support, and wherein the support is free to move within the wellbore.

5160. (previously presented): The method of claim 5156, wherein at least one of the heating elements comprises a mineral insulated cable suspended from a wellhead.

Remarks

Claims 2619, 2621-2630, 2632-2657, and 5150-5160 are currently pending. Claims 2619, 2621, 2624, 2626-2628, 2642, 2645-2648, 2650, 2653, 5151, 5154, 5156, and 5159 have been amended for clarification and/or correction of typographical errors.

A Fee Authorization is enclosed to cover fees associated with the request for continued examination. If additional fees are required or if fees have been overpaid, please charge or credit those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel, P.C. Deposit Account Number 50-1505/5659-06500/EBM.

Respectfully submitted,

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